



Technology that Provides Answers

**Kintama Research Services
4737 Vista View Cres
Nanaimo, B.C.
Canada V9V 1N8
T: (250) 739-9044**

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Mr Erik Merrill
Manager, Scientific Review Program
Northwest Power and Conservation Council

Re: Rebuttal of Fish Passage Center Memo 53-20 & Schaller et al. Memo

"A wise man, therefore, proportions his belief to the evidence." -David Hume

"Nothing is more dangerous than a dogmatic worldview—nothing more constraining, more blinding to innovation, more destructive of openness to novelty." -Stephen Jay Gould

Dear Mr. Merrill,

The Fish Passage Center (FPC) released [memo 53-20](#) criticizing our recent [paper published in Fish and Fisheries](#). The Independent Scientific Advisory Board (ISAB) has now been charged with reviewing our paper and the FPC's memo. Here we provide a detailed response to the FPC's claims ([Appendix I](#)).

In your earlier email advising us of the ISAB's remit, you also included a separate review by Howard Schaller, Charlie Petrosky, and Margaret Filardo dated 23 Nov 2020. Although many of the comments are similar to the FPC's claims, these authors raise some important additional issues. We have provided a separate point-by-point response to the Schaller et al. review as well ([Appendix II](#)).

We have also attached three additional appendices documenting some of the correspondence generated while drafting our paper or while preparing our response to the FPC memo ([Appendix III](#), [Appendix IV](#), & [Appendix V](#)). See the last page of this letter for a summary of what each appendix contains. All appendices are hosted on Kintama's website and can be accessed via embedded hyperlinks from this letter.

The FPC memo is oddly misleading in places, leading us to wonder how they came to the conclusions they did. For example, they state that we did not separate important ecological groups of salmon in our analysis when we explicitly stated in our paper that we did just that. In other cases, the FPC simply ignored without explanation our finding that significant amounts of their own data do not support their past claims. Their rather rushed reading may explain why they felt



that our methods of analysis were inappropriate. The Schaller et al. memo is more nuanced. Our responses are intended to add perspective on why we believe that the conclusions we reached in our paper remain valid. We recognize that our results do not align with current management approaches and that many interested in salmon conservation may lack the technical background to judge between these competing views. We hope the ISAB review will provide some needed clarity on this debate.

Please feel free to distribute our response beyond the ISAB members as you think this would be useful. We are distributing our response more widely to promote broader discussion of the issues (see Distribution section below).

In the remainder of this letter, we wish to place the results in our paper in a broader context. In our paper, we pointed out that survival to adult return (SAR) estimates for Chinook salmon stocks from many regions have fallen to roughly 1%, which is similar to levels reported for the Snake River populations. That biologists did not raise this issue earlier is remarkable—one would hope that they would either have investigated their monitoring programs to see why they were producing such “bad” numerical estimates or raised the alarm earlier that reported survival levels were in serious trouble coastwide. Neither happened. It is for this reason that in our paper we called on the funding agencies (and not the fundees) to drive a review of the programs. We welcome the ISAB’s review as an important first step towards that debate.

These are the issues/conclusions we see as most important:

- (1) If coastwide Chinook SARs are numerically similar to the Snake River, then it is difficult to argue for a major role of regional freshwater factors (such as the Snake River dams) as driving the current low survivals. This does not mean that freshwater habitat is unimportant, as the FPC claims we said. It does mean that if the major problem is in the ocean then “fixing” something else may be ineffective, no matter how well-intentioned those efforts are. We made an interesting advance here when considering the FPC’s argument that differences in the number of data points used in our 2010-2014 comparison of regional SARs relative to the Snake River region somehow erroneously resulted in similar SARs. To address this, we assessed relative survival between regions on an annual basis using all available years in the time series. We found that the year-by-year comparison of regional SARs to the Snake River resulted in the same conclusion of similar or lower SARs in most regions. We also found that SE Alaskan hatchery and wild yearling Chinook SARs fell in parallel over the available record. As Alaskan hatchery Chinook have no freshwater phase (hatchery smolts being released directly into the sea), this excludes freshwater smolt survival as a component of the decline in survival. This is an important new result, strengthening the results in the original paper.
- (2) The assumption underlying the delayed mortality theory (namely, that earlier hydrosystem experience is the cause of poor marine survival of Snake River populations relative to downstream populations), is unsupported when a wider range of populations is examined. Higher returns relative to Snake River populations are unique only when comparing wild Snake River spring Chinook to wild Yakima and John Day River spring Chinook which the FPC consistently report (and cited again

in their memo as evidence for delayed mortality). The FPC dismiss the multiple PIT or CWT tag-based survival comparisons we discussed in our paper because our examples extend to hatchery spring Chinook and fall Chinook from the Snake River. For example, wild Snake River fall Chinook (and wild upper Columbia River fall Chinook) have higher PIT-tagged based SARs than two wild mid-Columbia River fall Chinook populations. What is the rationale for limiting the delayed mortality theory to only *wild* Snake River spring Chinook? When the productivity of other populations is considered, evidence for delayed mortality diminishes or vanishes. This is a critical issue in our view, because if the delayed mortality theory is wrong Columbia River salmon management can probably focus on ensuring adequate levels of smolt survival in the river and not be held accountable for poor marine survival.

- (3) Since 1999, the terms of the renegotiated Pacific Salmon Treaty have acted as a negative feedback system (increasing harvest when survival is good and decreasing harvest when survival is poor). If the CSS reports fail to incorporate harvest into PIT tag-based SARs, statistical correlations of freshwater effects such as water travel time or spill on projected SARs¹ are compromised, obscuring and countering the effects of FCRPS operations on survival. The FPC acknowledges in their memo that they are aware of the high ocean harvests of fall Chinook and the (likely) low levels of ocean harvest on spring Chinook, but they are silent on potential biases in their SAR estimates that will result from ignoring harvest. Given the harvest levels we reported, we believe that the ISAB should provide its advice as to whether it is scientifically defensible to ignore harvest in statistical assessments of how freshwater manipulations may influence adult survival.

Current NWPCC recovery standards for the Columbia River Basin are essentially based on returning to the now ancient levels of productivity documented by Raymond half a century ago. Those levels are not reached anywhere else in western North America, apart from a few clearly exceptional individual populations (see our paper). It may now be impossible to reach past survival levels because they reflect older levels of productivity obtained in a colder ocean. It will likely be impossible to reach them until we understand why the few populations (highlighted in our paper) that do achieve them are successful.

Another barrier to salmon recovery in the Columbia River is that many of the players are deeply vested in supporting an outdated approach which almost reflexively blames the dams. Our paper shows that few regions along the west coast of North America are doing better than the Snake River and many are doing worse. This is probably because past issues caused by the dams have likely been fixed. What remains to be fixed during downstream and upstream migration is tiny... and far too low to reach current NWPCC SAR targets (see below). Twenty-one years ago, Kareiva et al (2000) wrote that “*even if main stem survival were elevated to 100%, Snake River spring/summer chinook salmon would probably continue to decline toward extinction*”. Remarkably, salmon conservation in the Columbia River Basin has not significantly progressed since then beyond freshwater studies.

¹ For example, if managers overshoot in their harvest modifications relative to perceived Chinook abundance prior to Chinook recruiting to the fisheries, they will overharvest in years of high abundance and underharvest in years of poor survival. This will flip the sign of any statistical exercise correlating freshwater conditions and returning SARs unless harvest is accounted for.

Failing to question current thinking also means that the possibility of generating efficient, cost-effective, and CO₂-free hydroelectric power in support of the growing use of sources of intermittent renewable power (wind and solar) is also constrained—past problems associated with the dams may have been fixed, but large elements of the salmon conservation community are reluctant to move on and address the ocean issues that are now the major issue because they are still fighting yesteryear’s battles.

We have recently written [elsewhere](#) (Welch, 2020) that the Columbia does not have a problem with smolt survival in freshwater (which is high), but rather with the insufficient adults returning from the ocean (which is low). It is straightforward to show that smolt survival levels cannot be manipulated to achieve high adult returns and it is worthwhile to take the time here to briefly demonstrate why.

Average survival through the FCRPS for out-migrating Snake River Chinook smolts is ~53%, while adult returns (SARs) average 1.0% (Haeseker, McCann, Tuomikoski, & Chockley, 2012). These numbers immediately demonstrate that the Columbia does not have a freshwater survival problem caused by the dams; rather, it has a lack of sufficient adults returning from the ocean to satisfy demand.

Consider how the current low SARs of ~1% is achieved:

$$SAR_{Current} = S_{FCRPS} \cdot S_{LRE} \cdot S_{Ocean},$$

The PIT tag-based SAR level is the combined product of survival in the FCRPS, the lower river and estuary (LRE), and the ocean. Investing in further changes to the FCRPS that significantly increased hydrosystem survival would result in an increase in the future SAR level to

$$SAR_{Future} = S_{FCRPS} \cdot (1 + \Delta) \cdot S_{LRE} \cdot S_{Ocean}$$

Thus, the future SAR level will be only:

$$SAR_{Future} = SAR_{Current} \cdot (1 + \Delta)$$

Even substantial further improvement in smolt survival through the FCRPS of, say, $\Delta=10\%$, has only a tiny effect on the adult return rate, increasing the SAR from 1.0% to 1.1%. Precisely because hydrosystem survival is already so high ($S_{FCRPS} \approx 53\%$), future SARs can only increase to $(0.53)^{-1} = 1.9\%$. Yet increasing the SAR from 1% to 1.9% would require eliminating all sources of mortality in the FCRPS: wiping out all predatory animal life (e.g., all birds and fish), vanquishing all diseases, and eliminating all direct dam impacts so that FCRPS survival increases from 53% to 100%.

It is for this reason that the theory of delayed mortality plays such an important role in the Columbia River Basin—the theory is critical to maintaining a focus on the dams as the way to “fix” poor ocean survival. Without delayed mortality there is no mechanism for current SAR recovery targets to be achieved. (Incorporating lower river and estuary survival ($S_{LRE} \approx 80\%$))

measured by the previous JSATs or POST telemetry arrays makes little difference, so for simplicity we subsume this in the ocean estimates of survival).

We remain concerned that most regions of the west coast, including the Columbia, are ill-prepared to deal with the coming levels of ocean climate change and resulting poor marine survival of salmon populations. The inability of any region of the west coast to improve freshwater survival by an amount anywhere near sufficient to compensate for past decreases in marine survival (let alone counteract the far greater decreases in survival likely coming) should be considered evidence that current approaches are not working.

SUMMARY

In WW2, analysis of returning U.S. warplanes identified where most shrapnel or bullet holes were found. That analysis was initially used to prioritize regions of the plane that should be better armored. However, eventually Abraham Wald—a brilliant statistician attached to the classified Statistical Research Group at Columbia University—pointed out that the study was looking at data on where a plane could survive being struck and still return. Only when the analysis was re-framed did it become clear that returning planes were rarely struck in the cockpit, the engines or fuel tanks... something that was lost to those studying the holes (Ellenberg, 2015).

In the example above, two radically different interpretations of the same data were possible. The same is true of Columbia River salmon conservation work and similar efforts coastwide. Collectively, we focus great efforts on highly visible freshwater habitats that now form the central pillar for salmon stewardship because freshwater habitat is important to the salmon's life cycle. However, being good freshwater stewards is not the same thing as addressing the major conservation challenges. Compensating for declines in marine survival may require enhancing freshwater habitat to an impossible degree. First, if survival levels are now similar coastwide, then regional declines likely cannot be compensated by fixing situations unique to one area, such as dams in the Snake River. Second, we are unaware of freshwater habitat restoration work that is identifying *improvements* in survival anywhere near the magnitude needed to compensate for worsening marine survival; see, for example, (Krall, Clark, Roni, & Ross, 2019).

2020 is already the [5th year in the 7 year period](#) 2014-2020 to be defined as having extensive marine heatwaves (2020 was the 2nd largest since 1982). Further large increases in north Pacific sea temperatures over the next decade are forecast (Arguez et al., 2020). The analysis of SAR data in our paper stopped in return year 2014 because of lags in data production and thus mostly exclude the SARs experienced under recent marine heatwaves. The decreased adult returns from those conditions are just returning now and have been catastrophic in many regions. Decreases in marine survival are not restricted to the Columbia with its extensive network of dams; British Columbia is now seeing [the lowest salmon returns in a century](#) and [Washington State is experiencing similar low levels of salmon returns in regions unaffected by the Columbia River dams](#). Unfortunately, things are likely going to get even worse in future.

If marine survival drops to zero, the current normative river philosophy of speeding smolt entry into the ocean will expedite extinction. Somewhat less extreme, increasing spill to speed smolts entry into the ocean will also decrease adult returns unless survival during the extra time spent in the ocean is better than the losses smolts would otherwise experience during the extra time spent



migrating downstream. Such considerations are not factored into the current debates about improving salmon returns.

No matter how admirable the intent, modifying conditions in a different part of the life history will not improve salmon returns unless those modifications can pass two tests: (1) they actually improve survival (i.e., are not just assumed to do so), and (2) they are large enough to materially contribute to compensating for the large decreases in marine survival. Few freshwater survival studies demonstrate either; the important Krall et al (2019) study in Washington State, for example, found no material improvement. They concluded that their carefully designed, decade-long study was statistically underpowered. Yet the data they reported showed no meaningful change in abundance in response to freshwater habitat improvements, not that increases in abundance occurred, but were statistically insignificant.

Our paper points out that in most areas of the coast survival has fallen to about the same level. Understandably, people are upset and angered by the implications of that message. However, one of our major points is that simply redoubling efforts on initiatives *in life history periods not causing the decrease* is unlikely to succeed. There needs to be a broader conversation about whether the large public expenditures in salmon recovery are actually working, rather than simply accepting that ever-increasing amounts of money will fix survival. It is our hope that the ISAB and others reading this reply will comment on these broader conclusions as well as assessing the technical credibility of our paper and the criticisms that have been levelled at it. It is past time for an adult conversation.

Sincerely,

David Welch, Ph.D., Aswea Porter, M.Sc, Erin Rechisky, Ph.D.
Kintama Research Services Ltd.
david.welch@kintama.com

[Appendix I](#) Our response to the FPC memo.

[Appendix II](#) Our response to the Schaller et al. memo.

[Appendix III](#) Comments received from five anonymous peer reviewers and the journal's Editor prior to publication, as well as our detailed responses. We include this in the interest of transparency and to partially address the FPC's claim that our paper fails to meet the journal's standards.

[Appendix IV](#) Correspondence with the Pacific Salmon Commission's Chinook Technical Committee to clarify the FPC's claim that we misrepresented that data source.

[Appendix V](#) Our letter to Ms DeHart of the FPC dated 18 September 2019, formally requesting that the FPC provide us with the CSS's PIT tag-based SAR estimates incorporating smolt survival above the topmost dam. We include this because the FPC argues in their current memo that differences between the PIT and CWT-based SAR estimates means that comparison of the two survival estimates is "apples to oranges". For the record, we never received any response to our request for the data in a way that would have reduced the disparity.

DISTRIBUTION:

William.Tweit@dfw.wa.gov; tucker.a.jones@state.or.us; chpetersen@bpa.gov;
bdzelinsky@bpa.gov; jcsweet@bpa.gov ; gill@psc.org; jonathan.carey@noaa.gov;
john.carlile@alaska.gov; antonio.velez-espino@dfo-mpo.gc.ca ;
kcmehaffey@newsdata.com; bcrampton@cbulletin.com ; kurt@nriverpartners.org ;
jmurauskas@fourpeaksenv.com ; jclee@usbr.gov; mdixon@usbr.gov ;
redfish@bluefish.org ; craigmedred@gmail.com ; mdehart@fpc.org;
adam.j.storch@state.or.us ; Erick.S.VanDyke@coho2.dfw.state.or.us; lort@critfc.org;
lotr@critfc.org; LESR@critfc.org; GOLC@critfc.org; ED.Bowles@state.or.us;
lance.hebdon@idfg.idaho.gov; tim.copeland@idfg.idaho.gov;
Daniel.Rawding@dfw.wa.gov; twitwmt@dfw.wa.gov; Michael.Garrity@dfw.wa.gov;
Steve.Haeseke@fws.gov; david_swank@fws.gov; ritche.graves@noaa.gov;
jayh@nezperce.org; zpenney@critfc.org ; jmccann@fpc.org; bchockley@fpc.org;
ecooper@fpc.org; gscheer@fpc.org; bobbyhsu@fpc.org; scott@s4s.com

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